CHROMOSOMES OF SOME PLANTS FROM THE KRUGER NATIONAL PARK*

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At the Tenth International Congress of Genetics in Montreal in August, 1958, the writer read a paper in which he gave the chromosome number of 57 species of South African plants, including new counts for 15 genera and for 29 species of genera in which the chromosome number of other species had been recorded.[15] The chromosomes of many of the genera and species were illustrated by photo-micrographs which had been made into lantern slides. Some of the species reported were from the Kruger National Park and, since the flora of that region is different in many respects from that of other parts of the Union, a more complete description of the Kruger Park plants will be presented here.

Chromosome studies were made from the root tips of seeds freshly germinated on filter paper in sterilized petri dishes. The seeds were received in 1955 through the kindness of Mr. H. P. van der Schyff of the University of Pretoria, who was formerly a park naturalist in the Kruger National Park and who had collected them between 1952 and 1955. The slides were prepared by Mr. Victor J. Hoff by several different techniques, but the method most extensively used was that of Bhaduri and Ghosh[3], and, in general, some chemical such as 8-quinolinol or para-dichlorobenzene was used to shrink and spread the chromosomes. Voucher specimens were prepared whenever possible and are being kept at the University of Kentucky. The arrrangement of plant families is that found in Hutchinson's "Families of Flowering Plants"[8], and Codd's "Trees and Shrubs of the Kruger National Park"[4] has been consulted for supplemental information.

OBSERVATIONS.

Fourteen species of 13 genera gave sufficiently good preparations for a chromosome study and the results obtained from them along with the most satisfactory technique are given below.

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Momordica clematidea Sond. Family Cucurbitaceae.

This species is a vine and has been found near the Crocodile River in the southern end of the Park. Chromosome numbers have not been determined previously for this species but the $2n$ number is 22 in *M. balsamina*[12] and *M. charantia*[2, 11, 20] and 28 in *M. dioica*[14].

The seeds were collected in February, 1953, at mBiamide. The chromosomes did not stain with aceto-carmine or aceto-orcein but were well stained with the Bhaduri-Ghosh[3] technique. There are 28 chromosomes in the root-tip cells and there is not a great difference in size (Fig. 5).

Terminalia phanerophlebia Engl. & Diels. Family Combretaceae.

This small tree is nowhere plentiful in the Park; it is also found in Zululand and Portuguese East Africa. It apparently has not been studied cytologically previously, but a $2n$ number of 24 has been reported for the related *T. catappa*[17].

Seeds were collected at the Nahpe Road in 1952. Good preparations were obtained by the Bhaduri-Ghosh[3] method and by fixing in 2 per cent chromic acid and staining with Feulgen. The $2n$ number is 36 (Fig. 2). Since the base number is apparently 12[6] this plant must be a triploid. The chromosomes do not show much size variation and all appear to have median or sub-median centromeres.

Adansonia digitata L. Family Bombacaceae.

Common names: baobab; cream of tartar tree; lemonade tree; monkey-bread tree; shimuwu (in Shangaan).

The baobab grows to 40—60 feet tall with a circumference of 60—70 feet. In the Union it is found only in the northern and north-eastern part of the Transvaal: it grows chiefly in the northernmost region of the Park, but one isolated tree can be found as far south as the Olifants River. From there it extends northwards to Abyssinia and westwards to Senegal and Guinea and is also found in Angola and Portuguese East Africa. Apparently no chromosome counts have been made in the genus but two related genera have been studied cytologically. Their chromosomes are numerous. The $2n$ number was reported as ca. 72 in *Bombax malabaricum* by Janaki-Ammal[6], 72 or 80 in *Ceiba* (*Eriodendron*) *pentandra* by Heyn[7] and as 88 in *C. indica* by Tjio[18] and in *C. occidentale* by Heyn[7].

The chromosome number is difficult to determine because the chromosomes are small and numerous and because the root tips contain some chemical substance between the cells that stains yellow with Feulgen and bright red with aceto-carmine, is not removed with turpentine and generally obscures the cellular contents. The chromosomes stain very poorly with aceto-carmine or aceto-orcein and not much better with Feulgen. Seeds were collected in 1953 from Pafuri in the northern part of the Park. The best results were obtained with the Bhaduri-Ghosh technique and show about 96 small, rounded chromosomes that look much alike (Fig. 3).

Cassia abbreviata Oliv. var. **granitica** Bak. f. Family Caesalpiniacae.

Common names: Long-tail Cassia; kersboom (in Afrikaans = candle tree); nnumanyama (in Shangaan).

Previously called *C. granitica,* this tree is now regarded as a variety of the tropical *C. abbreviata.* It is scattered throughout the Park and extends northwards to Uganda. Apparently no cytological work has been done on this species previously, although chromosome counts have been obtained for 31 other species of the genus. They are too numerous to list, but the $2n$ numbers reported are 14, 16, 24, 26, 28, 32, 48, 52 and 56 and the base numbers are apparently 6, 7 and 8.

The seeds were collected in 1953 from an undesignated region. The best slides were from root tips pretreated with paradichlorobenzene, fixed in 2 per cent chromic acid and stained with the Feulgen stain. The $2n$ number is 28 (Fig. 1). In general, the chromosomes tend to be clumped together on the metaphase plate and do not spread apart in many cells.

Cassia sp. Family Caesalpiniaceae.

These seeds were from an unidentified plant growing at Punda Maria. Slides were prepared by the Bhaduri-Ghosh technique. Twenty-eight chromosomes were observed (Fig. 4).

Dichrostachys nyassana Taub. Family Mimosaceae.

Common names: Sicklebush; Kalahari Christmas tree; sekelbos (in Afrikaans); ndzenga (in Shangaan). The same names are also applied to *D. glomerata* (Forsk.) Hutch. and Dalz.

This tree is the common sicklebush of open woodland in the southern part of the Park. Apparently no count was made upon this species, but a $2n$ number of 56 was reported by Atchison[1] for *D. glomerata.*

Chromosomes stained well with both the Bhaduri-Ghosh technique and with chromic acid fixation followed by the Feulgen stain. The chromosomes were counted in a large number of metaphase plates and the $2n$ number seemed clearly to be 50. The chromosomes were small and of about the same general size (Fig. 6). Because of Atchison's count on *D. glomerata,* the chromosomes were studied particularly carefully and in no cell could 56 chromosomes be seen. This difference in chromo-

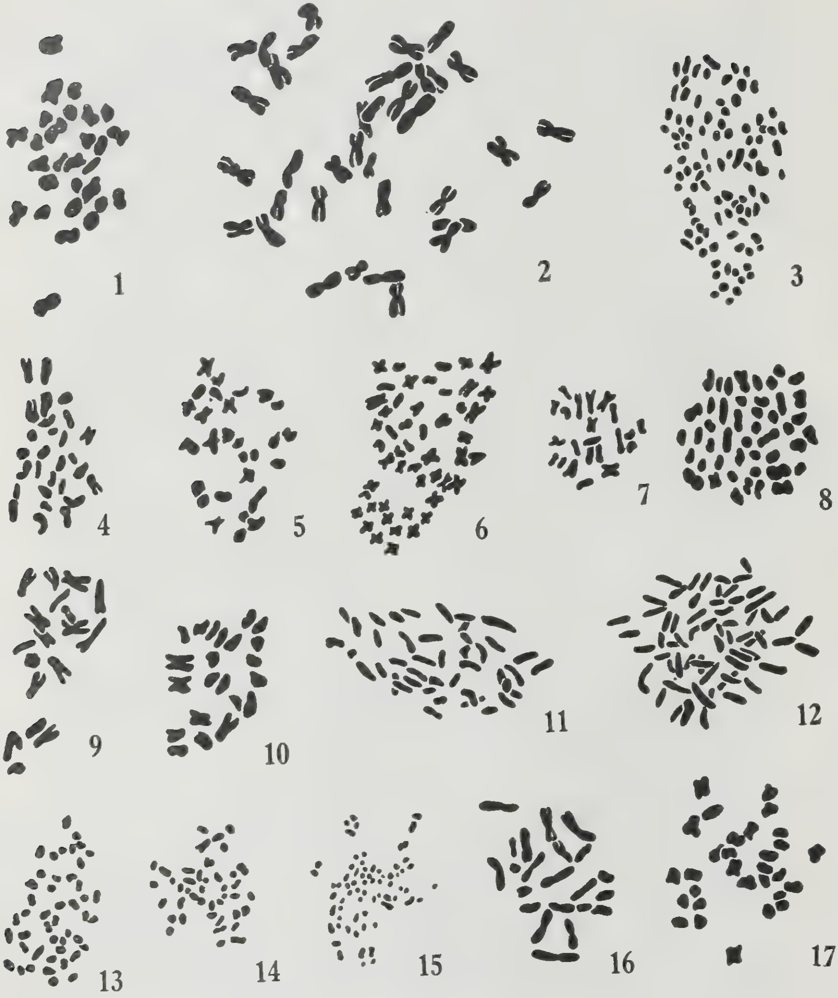

FIG. 1—17.—Somatic chromosomes of some species of South African plants. Fig. 1. *Cassia abbreviata* var. *granitica* ($2n = 28$). Fig. 2. *Terminalia phanerophlebia* ($2n = 36$). Fig. 3. *Adansonia digitata* ($2n = 96$). Fig. 4. *Cassia* sp. ($2n = 28$). Fig. 5. *Momordica clematidea* ($2n = 28$). Fig. 6. *Dichrostachys nyassana* ($2n = 50$). Fig. 7. *Abrus precatorius* ($2n = 22$). Fig. 8. *Baphia obovata* ($2n = 46$). Fig. 9. *Bolusanthus speciosus* ($2n = 18$). Fig. 10. *Canavalia* sp. ($2n = 22$). Fig. 11. *Erythrina lysistemon* ($2n = 42$). Fig. 12. *Erythrina lysistemon*, a triploid cell ($3n = 63$). Fig. 13. *Berchemia discolor* ($2n = 46$). Fig. 14. *Berchemia discolor* ($2n = 42$). Fig. 15. *Berchemia discolor*, a triploid cell. ($3n = 69$). Fig. 16. *Adenium multiflorum* ($2n = 22$). Fig. 17. *Ipomoea albivenia* ($2n = 30$). All figures approximately 2,300 after reduction.

some number is very interesting because these two species are apparently very closely related, so closely, in fact, that Codd[4] states: "The main difference between those two species lies in the character of the leaves, *D. nyassana* having larger and smoother leaves and larger leaflets". According to Darlington and Wylie[6] the base number of Dichrostachys is 14. Therefore, *D. glomerata* is a tetraploid. If *D. nyassana* has six fewer chromosomes, their loss would not be so significant from a tetraploid. It might, however, be enough to modify the size and texture of the leaves and thus cause the origin of a new variety.

Abrus precatorius L. Family Papilionaceae.

Common names: Love bean, lucky-bean climber; nsisani (in Shangaan).

This species is a vine with stems $\frac{1}{2}$—$\frac{3}{4}$ in. thick and bears small, hard, red-and-black seeds. It is widely distributed in Africa and Asia and is scattered throughout the Park. Previous chromosome studies gave 22 as the $2n$ number[13, 16].

Seeds were collected in 1953 near Pretorius Kop. In general, the chromosomes did not stain easily and they did not stain at all in aceto-carmine although they were stained fairly well in a mixture of aceto-carmine and hematoxylin. Staining with Feulgen was poor but was better when the cells were smeared in hematoxylin and aceto-carmine after the Feulgen stain and was also better with Feulgen when pretreated with paradichlorobenzene than with bromonaphthalene. Twenty-two small chromosomes were found (Fig. 7).

Baphia obovata. Family Papilionaceae.

This genus is primarily tropical and is not listed by Codd[4]. The seeds used in this study were collected at Wambia in May, 1954. Apparently, the only chromosome count in the genus is that of *B. nitida* by Mangenot and Mangenot[10] in which the $2n$ number is given as about 48.

Chromosomes prepared by the Bhaduri-Ghosh[3] method or pretreated with a mixture of coumarin and oxyquinoline and stained with the Feulgen stain were poor, but excellent results were obtained by prefixation in paradichlorobenzene and oxyquinoline followed by fixation in acetic alcohol (1 : 3) and staining with the Feulgen stain. The chromosomes are numerous and do not spread readily, and are therefore rather difficult to count. The clearest figures, however, indicate that the $2n$ number is 46, at least in most cells (Fig. 8). The chromosomes do not differ much in size although the longest are about three times the size of the shortest. In most, the centromeres are median or submedian.

Bolusanthus speciosus Harms. Family Papilionaceae.

Common names: Tree wistaria; elephantwood; Vanwykshout (in Afrikaans); mpfimbahongonji (Shangaan); umHohlo (in Swazi).

This tree is common in the Park, especially in the southern part, and occurs northwards to Nyasaland and Angola. Chromosome numbers have been reported very recently by Turner and Fearing[19], who found 18 chromosomes in somatic cells.

The chromosomes of the present study were prepared by the Bhaduri-Ghosh[3] technique from seeds collected in 1953 at Pretorius Kop. They are all of about the same size and the $2n$ number is 18 (Fig. 9).

Immediately after staining, the cells were uniformly pink but after the slides had remained overnight the chromosomes took on a light red stain and were clearly seen. However, much better staining was obtained if, after standing several hours, the cover slip was gently lifted and a drop of haematoxylin was added to the stain.

Canavalia sp. Family Papilionaceae.

This is one of the herbaceous or somewhat shrubby genera found in the Park. Chromosome numbers of 22 and 44 have been reported for three species of the genus by Kawakami[9], Simmonds[17] and Covas[5].

Seeds were collected at Numbi. Several methods of pretreatment, fixation and staining were tried but the best results were obtained when the root tips were pretreated in a mixture of paradichlorobenzene and 8-oxyquinoline and stained with the Feulgen stain. The $2n$ number was 22 (Fig. 10), and the chromosomes did not differ greatly in size.

Erythrina lysistemon Hutchinson. Family Papilionaceae.

This species is a segregate from *E. caffra* Thunb. but is not recognized by Codd[4]. Common names of *E. caffra* are kaffirboom (in Afrikaans), muvale and nsisimbane (in Shangaan) and umSisi (in Swazi). Atchinson[1] gives 42 as the chromosome number of *E. caffra* and 84 as that of *E. acanthocarpa*, another South African species.

Seeds of *E. lysistemon* were collected at Pretorius Kop in 1952. Several techniques were used and the best was fixation in acetic-alcohol (1 : 3) and staining with the Feulgen method. The Bhaduri-Ghosh method did not give as good results; tissues fixed in acetic-alcohol did not stain with aceto-carmine or aceto-orcein, but those fixed in chromic acid were lightly stained. As Atchinson found for *E. caffra*, the chromosome number appears to be 42 (Fig. 11), so that chromosome numbers cannot be used to decide whether *E. lysistemon* should be separated taxonomically from *E. caffra*. Several cells had aberrant chromosome numbers such as $2n = 55$ and $2n = 63$, a triploid (Fig. 12).

Berchemia discolor Hemsl. Family Rhamnaceae.

Common names: Bird plum; wild almond; wilde amandel (in Afrikaans); nyiyi or nyiri (in Shangaan).

This species is a medium to large tree, is rather rare in the Park, and is found in the northern Transvaal and Bechuanaland to Abyssinia. No chromosome studies have been made in this genus, but the base numbers of chromosomes for other genera of the family appear to be 10, 11, 12 and 13 and some diploid numbers are as high as 72 and 96.

Chromosomes prepared by the Bhaduri-Ghosh method gave poor results, but excellent preparations were obtained when the root tips were pretreated with a mixture of paradichlorobenzene and 8-oxyquinolinol. The chromosomes are small and numerous and there seems to be some variation in the number of chromosomes in different cells of the same root. In most of the cells 46 chromosomes were found (Fig. 13) and the $2n$ number can probably be considered to be 46, but some cells that seemed quite clear had 41, 42, 44, 45 or 48 chromosomes (Fig. 14), and in one the number was 69 (Fig. 15). There is some variation in chromosome size as some of the chromosomes are two to three times as long as others.

Adenium multiflorum. Family Apocynaceae.

Common name: Impala lily.

This species is a succulent-stemmed shrub with branches arising from a thick, underground tuber. It is scattered throughout the Park and also grows in the Transvaal, Portuguese East Africa and Nyasaland. No chromosome studies have been made on Adenium, but chromosome numbers of species in other genera of the Apocynaceae are given as 16, 18, 20, 22, 24, 36, 40, 44, 46 and 92.

Slides were prepared by prefixing in 1-bromonaphthalene or paradichlorobenzene, fixing in 1 per cent chromic acid and staining with the Feulgen technique. Both methods gave good results. The chromosome number was 22 and there was considerable difference in chromosome size, the longer chromosomes being about five times as long as the shorter (Fig. 16).

Ipomoea albivenia. Family Convolvulaceae.

This species is a shrubby perennial climber and is found in the southern part of the Park, in adjoining regions outside the Park and in Natal and Portuguese East Africa. Chromosomes in related species are listed in Darlington and Wylie[6] as 30, 32, 60 and 90 with a base number of 15, but apparently no South African species have been studied.

Seeds were collected in July, 1953, at Siclabe Mountain between Pretorius Kop and Skukuza. Slides were prepared by the Bhaduri-Ghosh method. Metaphase plates were clear and 30 chromosomes of more or less the same size were observed (Fig. 17).

SUMMARY.

Chromosome counts are given for fourteen plants from the Kruger National Park. Four are new genus counts and six are new species counts in genera in which other species had previously been counted.

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